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लिग्नाइट के पेट्रोग्राफिक विश्लेषण की पद्धतियाँ

भाग 1 लिग्नाइट के पेट्रोग्राफिक विश्लेषण से संबंधित पारिभाषिक शब्दों की परिभाषा

Indian Standard

METHODS OF PETROGRAPHIC ANALYSIS OF LIGNITE

PART 1 DEFINITION OF TERMS RELATING TO PETROGRAPHIC ANALYSIS OF LIGNITE

ICS 74.040

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Price Group 2

Solid Mineral Fuels Sectional Committee, PCD 7

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the Solid Mineral Fuels Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Petrographic analysis has been recognized internationally as important in the context of the genesis, vertical and lateral variation, continuity, metamorphism and usage of lignite. Micropetrographic studies of individual lignite provide rich information about maturity (rank) of a lignite along with its maceral *vis-à-vis* mineral distribution. The precursors of vitrinite in lignite stages, are known as huminite. Huminite with its maceral group analysis can give information about the different chemical and technological behaviour of the lignite.

Lignite is an organic sedimentary rock, the physical, chemical and technological properties of which depend upon its composition and its rank, that is, degree of metamorphism. It is derived from plant material and its composition is controlled by the nature of the deposited plant from which it was formed as well by its condition of deposition. Like most rocks, lignite can be divided into several microscopically recognizable rock types. When examined microscopically these rock types can further be subdivided into identifiable entities, called macerals.

The following standards cover methods for the petrographic analysis of coal:

IS No.	*Title*
IS 9127 (Part 1) : 1992	Methods for petrographic analysis of coal: Part 1 Definition of terms relating to petrographic analysis of coal (*first revision*)
IS 9127 (Part 2) : 2002/ ISO 7404-2 : 1985	Methods for the petrographic analysis of bituminous coal and anthracite: Part 2 Method of preparing coal samples (*first revision*)
IS 9127 (Part 3) : 2002/ ISO 7404-3 : 1994	Methods for the petrographic analysis of bituminous coal and anthracite: Part 3 Method of determining maceral group composition (*first revision*)
IS 9127 (Part 4) : 2001/ ISO 7404-4 : 1988	Method for petrographic analysis of coal: Part 4 Method of determining microlitho type, carbominerite and minerite composition
IS 9127 (Part 5) : 2004/ ISO 7404-5 : 1994	Methods for the petrographic analysis of bituminous coal and anthracite: Part 5 Method of determining microscopically the reflectance of vitrinite (*first revision*)

In this standard, due consideration has been given to international coordination among the standards and practices prevailing in different countries in addition to those relating to the practices in the field in this country and also from the experience derived from the cooperative work of the Central Fuel Research Institute (CSIR), Dhanbad, and The Indian School of Mines, Dhanbad, etc.

Indian Standard

METHODS OF PETROGRAPHIC ANALYSIS OF LIGNITE

PART 1 DEFINITION OF TERMS RELATING TO PETROGRAPHIC ANALYSIS OF LIGNITE

1 SCOPE

This standard (Part 1) explains and defines the terms that are used in connection with the determination of the maceral group composition of lignite in reflected light as well as blue light irradiation (fluorescence microscopy) and the determination of reflectance of huminite.

NOTE — This standard is neither intended to be a comprehensive glossary of lignite petrographic terminology, nor does it extend complete information to allow recognition of all the lignite components described. For further information, reference may be made to International Handbook of Lignite Petrography.

2 REFERENCE

The following standard contains provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

IS No.	*Title*
9127 (Part 1) : 1992	Methods of petrographic analysis of coal: Part 1 Definition of terms relating to petrographic analysis of coal (*first revision*)

3 DEFINITIONS

3.1 General Terms

3.1.1 *Coalification* — The transformation of vegetable matter into peat, lignite and coal through biochemical and geo-chemical processes is known as coalification.

3.1.2 *Peat* — It is unconsolidated, carbonaceous sediment of high moisture content formed by the accumulation of partly decomposed plant debris.

NOTE — Peat deposits may become buried and consolidated and transformed into lignite or coal by the process of coalification (*see* **3.1.1**).

3.1.3 *Lignite* — Lignite is a combustible, carbonaceous sedimentary rock formed from peat by diagenesis and metamorphism. Megascopically it is brown, dull and partly earthy. While under the microscope it has large pore volume and open cell lumens and its gelification is rare.

3.1.4 *Rank* — Rank is the stage of coalification reached by given lignite (coal). It is not directly measurable parameter but is a concept. To define it, it is necessary to refer to a specific physical or chemical or optical, for example, reflectance of huminite/vitrinite, calorific value, carbon content, bed moisture, volatile matter content, etc.

NOTE — The properties of the different macerals change according to different patterns with increase in rank and so ideally it is preferable to determine rank on one particular maceral. Vitrinite/huminite (eu-ulminite/levigelinite) is the best reference maceral. Reflectance (rank) determination of lignite should be made on eu-ulminite/levigelinite as these maceral types are completely gelified and have similar appearance to vitrinite of bituminous coal.

4 OPTICAL TERMS

Definitions for the various optical terms are covered in IS 9127 (Part 1).

5 PETROGRAPHIC TERMS

5.1 Definitions for the various petrographic terms are covered in 9127 (Part 1).

NOTE — In the maceral group instead of Vitrinite group in peat and lignite, this group is termed as huminite group (classification of macerals are shown in Table 1).

Table 1 Maceral Groups and Their Sub-divisions

(*Clauses* 5.1 *and* 6)

Maceral Group	Maceral Sub-group	Maceral	Maceral Type	Maceral Variety
(1)	(2)	(3)	(4)	(5)
Huminite	Humotelinite	Textinite	—	A (Dark) B (Light)
		Ulminite	Texto-ulminite	A (Dark) B (Light)
			Eu-ulminite	A (Dark) B (Light)
	Humodetrinite	Attrinite	—	—
		Densinite	—	—
	Humocollinite	Gelinite	Porigelinite	—
			Levigelinite	Eugelinite Telogelinite Detrogelinite
		Corpohuminite	Phlobaphinite	—
			Pseudo-phlobaphinite	—
Liptinite	Primary	Sporinite	—	Tenuisporinite Crassisporinite Microsporinite Macrosporinite
		Cutinite	—	—
		Resinite	—	—
		Alginite	—	Pila-alginite Reinschia-alginite
		Liptodetrinite	—	—
	Secondary	Suberinite	—	—
		Exudatinite	—	—
		Fluorinite	—	—
		Bituminite	—	—
Inestinite	Having plant cell structure	Semifusinite	—	—
		Fusinite	Pyrofusinite	—
			Degradofusinite	—
		Funginite	—	—
	Lacking plant cell structure	Secretinite	—	—
		Macrinite	—	—
		Micrinite	—	—
	Fragmented inertinite	Inertodetrinite	—	—

5.2 Huminite — The precursors of 'vitrinite' in the peat and lignite (brown coal in German classification) stages are combined together petrographically in the 'huminite' group. Huminite is divided into three maceral subgroups named as Humotelinite, Humodetrinite and Humocollinite based on the state of preservation of plant material and into macerals and sub-macerals depending upon the intensity of gelification and morphology. As these macerals only bear a few resemblances to their later coalification products in bituminous coals, they are therefore given different maceral names. Since the initial differences between plant remains are gradually reduced with increasing rank, there are more huminite macerals than vitrinite macerals. Huminite, in general, is characterized by dark grey colour and very low reflectance in incident white light.

5.2.1 *Humotelinite* — These are well-preserved humified tissues. Within this sub-group there are two macerals that is textinite and ulminite, which differ in their degree of gelification.

5.2.1.1 *Textinite* — These tissues are ungelified and still greatly resemble the original cell walls, being characterized by open cell lumens. There are two varieties — textinite A, which has lower reflectance, and textinite B with a higher reflectance than the associated humodetrinite.

5.2.1.2 *Ulminite, texto-ulminite and eu-ulminite* — Through biochemical and/or geochemical gelification, textinite alters into ulminite. On the basis of degree of gelification, texto-ulminite (partly gelified) are distinguished by partly closed cell lumens with weakly visible cell structure and eu-ulminite (completely gelified) are distinguished by closed cell lumens with no longer visible cell wall structure. Both can occur as varieties 'A' (weakly reflecting) and 'B' (strongly reflecting). Eu-ulminite has a similar appearance to vitrinite (telinite) of bituminous coal.

5.2.2 *Humodetrinite* — The intimate mixture of humic detritus with the most finely divided humic gel (usually $< 10\ \mu$), resulting mainly from strongly decomposed plant parts originally low in lignin and rich in cellulose, is termed humodetrinite in peat and lignite stages. Depending on the degree of gelification, humodetrinite is subdivided into two macerals attrinite and densinite.

5.2.2.1 *Attrinite* — The attrinite are finely divided detrital particles of different shape and size. These are mainly loosely packed porous gel having a 'spongy habit' and well differentiated from one another.

5.2.2.2 *Densinite* — In densinite the individual components are cemented tightly together as a result of biochemical and/or geochemical gelification process. The cemented areas are usually more than $15\mu^2$. These densinite may have varying shape-cell wall debris as well as formless, dense and almost homogenous huminitic materials

5.2.3 *Humocollinite* — Humocollinite results from colloidal humic solutions, which originate in peats and lignites into existing cavities where they precipitate as gels. This humic gel or humocollinite is divided into macerals, namely, gelinite and corpohuminite. In the lignite stage gelinite is divided into two maceral types porigelinite and levigelinite.

5.2.3.1 *Gelinite* — Gelinite are predominantly precipitated humic gels which are homogenous, without any definite form. Keeping with its genesis, gelinite frequently reproduces the shape of spaces of cell lumens filled by it. Depending on texture, two submacerals can be differentiated, namely, porigelinite and levigelinite.

a) *Porigelinite* — Porigelinite is very finely porous to granular. It fills up cavities such as shrinkage cracks, cleats and completely root organs, namely, root ducts.

b) *Levigelinite* — Levigelinite is dense and massive with typical desiccation cracks. It fills up cavities, namely, shrinkage cracks, cleats, etc. There are three varieties of levigelinite, for example, eugelinite, telogelinite and detrogelinite.

5.2.3.2 *Corpohuminite* — Cell fillings with huminitic reflectivities in peat and lignite are known as corpohuminite irrespective of whether they occur *in situ* or isolated. They can be primarily liberated as excretions from living plant-cell walls or be produced as secondary cell infillings from humic gels. They are grey to whitish grey in colour under reflected light, bright field; oil immersion depends on the degree of coalification.

a) *Phlobaphinite* — Phlobaphinites develop from phlobaphinitic cell excretions, which are brown or red coloured oxidation or condensation products of tannins, which form on death of the cell contents. These dark substances in the cell contents are found among other tissues, in the medullary rays and in the wood parenchyma of fallen trees. They are found in bark tissues, particularly in cork, and characteristic cork tissues with plate-like phlobaphinites are well known in lignites and Tertiary coals.

b) *Pseudo-phlobaphinite* — The non-phlobaphinitic part of corpohuminite is termed as pseudo-phlobaphinites of peats and lignites. The huminitic gel infiltrates into the plant cells/empty vessels of the roots during peat and lignite stages.

5.3 Liptinite

Definitions of primary liptinite (exinite) macerals are covered in IS 9127 (Part 1).

5.3.1 *Secondary Origin Liptinite Macerals*

5.3.1.1 *Suberinite* — Suberinite originates from the suberin of cork tissues. It often occurs with phlobaphinite, which is contained within the cork cells. Under reflected light, bright field, oil immersion suberinite is almost black, dark grey, or medium grey. Under fluorescence blue light irradiation they are lemon yellow to yellowish orange or brown.

5.3.1.2 *Bituminite* — Bituminite has no specific shape and structure. They are characterized by a low reflectivity, weak brownish fluorescence (or none at times). Its fluorescence intensity increases during irradiation.

5.3.1.3 *Exudatinite* — This bituminous material is produced by 'sweating' and deposited in cracks, open cell lumens, etc. during coalification. It shows a bright yellow fluorescence under blue light irradiation, while it is brownish black and/or black in white light.

5.3.1.4 *Fluorinite* — This maceral may be mistaken for lenses of clay minerals under the incident white light with oil immersion, because of their black colour and internal reflections. Under blue light irradiation this material shows a shining yellow colour.

5.4 Inertinite

Definitions for the various terms of the maceral types of this group are covered in IS 9127 (Part 1) and 'The new inertinite classification (ICCP system 1994)'.

6 CLASSIFICATION OF MACERALS

Three maceral groups are recognized. Maceral groups and their sub-divisions are shown in Table 1.

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